

Chapter 9

Financing Bioenergy Trade: Making It Happen

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Abstract The development of sustainable biomass supply chains for international biomass trade are a prerequisite to foster the growth of bioenergy applications worldwide. Setting up these supply chains is offering a broad array of interesting investment opportunities that could offer stable, long term and high returns. However, investment in the bioenergy supply chains is perceived by the finance sector to be risky and uncertain and therefore many projects do not materialize. At present, insufficient financing is an obvious obstacle for the development of efficient supply chains. In the chapter attempts are made to analyse and elucidate the causes for that perception in the finance sector and to suggest remedies. This chapter also highlights the different areas of investment that exist, the most important stakeholders along the investment process, the challenges that exist along certain bioenergy value chains and the need for far sighted and sound policy making to support and secure long term sustainable business models.

9.1 Introduction

The focus of this chapter is on investments needed that enhance the international trade of sustainable biomass.

During the first decade of the twenty-first century about 10 % of worldwide primary energy demand has been met with biomass based fuels (IEA 2007).

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Already more than 10 million tonnes of solid and liquid biofuels are being traded internationally per annum (Junginger et al. 2010) and according to the estimates of AEBIOM (2012) overall bioenergy consumption in Europe alone will grow from 100 million toe in 2010 to more than 120 million toe in 2020. An increasing share will be traded internationally in order to balance demand and supply and/or optimize costs.

The development of sustainable biomass supply chains for international trade is often capital intensive, technologically demanding and time consuming. However, without a stable and reliable supply of sustainably produced biomass not all bioenergy projects needed to meet renewable energy mandates can be realized or have to revert to unsustainable feedstock sources. It is believed that market forces alone will not suffice to balance supply and demand of biomass on a world wide scale – also due to different incentive schemes and trade distortions. Also politics have to play an active role in managing and guiding the development of biomass supply chains.

Biomass to energy value chains – especially when involving long haul biomass supply chains – are far more complex to establish and to manage than other renewable energy systems. Biomass availability might be volatile or seasonal and comes in a huge variety of specifications, there is a broad range of players involved from single farmers or land holders, project developers, private and institutional investors, transportations companies, traders up to internationally operating utilities. All with different agendas, ways of doing business and bargaining powers.

In addition different preconditioning technologies offer a broad range of intermediate biomass energy carriers – most of them requiring a specific conversion technology to convert them at optimum efficiency to power or fuel.

Finally the low liquidity of the international biomass market does not allow for large scale investments in e.g. biomass power plants without securing a significant amount of feedstock via long term contracts – leading to totally integrated and complex supply chains.

As a result the investments in international biomass supply chains are currently not sufficient to meet future renewable energy obligations. Long term trends of energy markets as well as supportive political and economic frameworks already today allow for robust business models in that investment class.

A proactive approach is needed by the bioenergy community in order to provide the financial world with information about potentially lucrative investment opportunities in biomass trade.

This chapter should therefore deal with the following questions:

- What kind of attractive business models exist along the biomass trade supply chain?
- What kind of investments are already being developed, where is a lack of activity today?
- Who will finance biomass trade related investments and business models?
- What kind of financial sources are available for those potential investors (grant, debt, equity)?
- How to align and synchronize renewable energy mandates with needed investments?

Concluding remarks will try to answer the questions of what could be done in order to support the growth of international biomass trade and what kind of economic or political incentives might still be missing.

9.2 International Biomass Trade and Investments

9.2.1 *Biomass Supply Chains of International Biomass Trade*

International imbalances of biomass supply and demand as well as biomass costs are the drivers of a growing international trade in biomass. International biomass supply chains differ in a number of points from local or national biomass supply chains that both add to their complexity but also offer new and exciting business and investment opportunities.

One important and mainly logistical aspect of those supply chain is the question of both the technical and economical *transportability* of the solid or liquid biofuel in question. Quite a few of sub criteria have to be fulfilled to have a transportable biomass product in that sense.

One of the criteria is *volume*. Only if a certain biomass fuel can be supplied in sufficient total volumes per year in order to allow for transports by e.g. sea going vessels a regular business can be established that both reduces overall costs and attracts investors. This is especially the case if specialized handling, storage or transport equipment might be needed along the supply chain. Only if whole bulk carriers can regularly be filled with e.g. energy pellets or energy wood chips of a well-defined quality international trade has a chance of getting started.

Especially the dedicated production of energy biomass can be a solution to securing high and continuous volumes of biomass. Here biomass is the target product and no longer a side product of other production chains and no longer depends on other industry cycles. In the case of dedicated biomass production often new plant traits and growing regimes are being developed in order to maximize overall energy content. Short rotation coppice with high yielding tree species, new and cost efficient tree planting and harvesting technologies as well as high biomass sorghum or maize plants are examples of new market and investment potentials mainly driven by an increasing bioenergy demand.

Creating the necessary liquidity of biomass in certain regions to establish international biomass trade is a business model in itself and has happened for example in British Columbia more than a decade ago. Nowadays there are more than 11 wood pellet plants operating in BC with a total capacity of more than 1.7 million tons of pellets per year – all destined for mostly European export markets.

Total internationally traded pellet volumes are around 8–10 million tons while soon the import to Europe alone has to rise to about 25–50 million tons during the next years to bridge the gap between expected demand and European supply.

In addition to scale also transport costs as such have to be optimized. Therefore the biomass fuel needs to have good **storage** and **handling** properties as well as a high volumetric **energy density**. Often biomass feedstock does not have some or most of these properties. That leads to the need of some form of technical pre-treatment prior to long haul shipments – a fact that led to the growth of a whole new set of biomass pre-treatment technologies during the last two decades such as wood pelletisation, torrefaction, flash pyrolysis, hydrothermal carbonization, enzymatic hydrolysis, etc. Wet wood chips have an energy density of about 8 GJ/t or 3 GJ/m³ in comparison to pellets with 17 GJ/t and even 11 GJ/m³. All these technologies are at different stages of their development and commercialization and offer a multitude of investment opportunities both on the development as well as on the application of these technologies.

International trade also needs a competitive and regulated environment in order to flourish without harming the environment. Biomass fuels traded worldwide need to follow common **specifications** in order to become commoditized to be easily tradable and allow for the development of financial instruments to manage risk of long and medium term supply agreements that in turn are the basis for investments needed along the total supply chain up to the end user. Besides the **commoditization** of biomass also the ecological and social **sustainability** of such fuels have to be guaranteed via specialized certification systems. Especially for exports to the EU – currently the biggest importer of solid and liquid biofuels, such certifications are compulsory. Therefore investments in easily certifiable and sustainable biomass resources could become very lucrative as demand for those qualities will rise in the future.

All these investment opportunities need to find the right source of finance to bridge the gap between project idea and project realization. Depending on the degree of technical and economic risk, the degree of innovation and IP generation as well as the degree of future income potential and market position, different portfolios of financial sources and financial tools are or could be made available.

9.2.2 Short Overview of Investment Activities in International Biomass Trade, Drivers and Future Bottlenecks

Main areas of investment along international biomass supply chains are the fields of dedicated biomass production, **biomass preconditioning**, **biomass logistics** and **biomass conversion**.

9.2.2.1 Production

With the increasing need for bioenergy fuels existing sources of biomass residues and waste do no longer suffice to meet demand or specifications. There are only a few biomass residues that are being produced on a continuous basis and in large

quantities that have all the needed properties as defined in the previous chapter to be directly suitable for international trade such as palm kernel shells in South East Asia.

In general dedicated biomass production will be the very starting point of most biomass value chains ensuring security of supply, absolute overall volumes for international logistics and continuous feedstock quality to meet specifications. A number of recent investment in pellet plants to supply overseas markets are based on such a feedstock base.

Dedicated production of woody energy biomass for export is still in its infancy and so far has only been started to serve local or regional biomass markets, such as short rotation coppice (SRC) in Europe – with a couple of specialized companies (e.g. Lignovis, Agroenergi) active in that field already. Total area covered by SRC in Europe is estimated to be as little as 18,000 ha although widely recognized as one of the future sources of sustainable biomass sources that easily competes with imports when measured in price per GJ delivered to the gate. The usage of existing pulp wood plantations in e.g. South East USA for the production of wood pellets via whole tree chipping could be interpreted as dedicated biomass production activities for bioenergy exports. Also in countries such as Brazil, South Africa and Australia energy wood plantations are being developed to cater for both local and international bioenergy markets.

In the case of liquid biofuel production already existing agricultural production technologies and concepts have been used to increase the production of sugar, starch and oil crops such as sugar cane in Brazil, maize in the USA, soya in Argentina and palm oil in Malaysia in order to divert significant volumes into the energy market.

Lignocellulosic biomass, however, can be produced very extensively with low external energy input. Especially in the case of e.g. reforestation projects its overall GHG balance can be very positive with a much lower – in some cases even beneficial – impact on biodiversity in comparison to high intensive agriculture.

These activities in dedicated biomass production need to be developed and managed sustainably to make sure that the fight against increasing GHG emissions through bioenergy use will not be a cause of other unnecessary environmental problems and distortions. So when thinking about a new project for dedicated biomass production it is important that investors make sure that the project will meet the criteria of the European sustainability legislation and can be certified accordingly. Only a certified biomass production is eligible to enter the important and growing European biomass market. Certification will also be a precondition for quite a number of financial sources such as grants and institutional investors and greatly enhances the chance of success and continuous growth.

9.2.2.2 Preconditioning

Biomass needs to be preconditioned to meet technical specifications and enhance its storage, handling and transport properties for long haul transport chains.

Pelletisation is currently the most ubiquitous form of solid biomass preconditioning for that purpose. Significant investments in pellet plants have been done

during the last ten years in order to make low cost biomass and biomass residues available for international markets. With Europe as the main importing nation, numerous pellet plants have been set in Western Canada, South East USA and Russia, almost totally geared towards the international biomass trade. Similar initiatives in South Africa and Australia have been seen but with limited economic success and low capacity utilization rates so far. The latest IEA task 40 pellet study (Cocchi et al. 2011) offers a good overview of the development and current status of the world wide wood pellet industry that had a total capacity of about 28 million t/a and a total output of about 14 million t/a in 2010. About 5–6 million tons of pellets have been traded on international routes the same year.

Another already commercially viable and implemented biomass preconditioning technology for international sales is wood chipping and drying with established supply chains based in e.g. in the South of the US for supplying dedicated biomass power plants in Europe. Such projects could be an ideal starting point in countries with a high surplus of low quality and sustainable energy wood and simple transport chains (few handling steps) to reach international markets. The mobilization of unproductive while over aged rubber trees from Liberian tree plantations – that needed to be cut down prior to replanting – to the international biomass market through Buchanan Renewable just made use of relatively low cost whole tree chipping and truck/ship transport.

Impressive amounts of investments were done also in biodiesel plants and ethanol plants to serve the fast increasing bio fuel market during the last decade. Those investments were concentrated in EU countries and the Americas (mainly USA, Brazil, Argentina). While some of the produce was also geared to international bio-fuel markets, already existing storage, handling and transport infrastructure for fossil transportation fuels provided sufficient capacity for those volumes to be transported at optimized costs to their respective destinations. With increasing biofuel consumption and based on well-established feedstock and transportation base, investments in biofuel plants have been very lucrative during the last decade. The projections by the OECD and FAO indicate that global production of ethanol will double to 125 billion litres by 2017 with biodiesel production rising from 11 billion litres in 2007 to about 24 billion litres in 2017.

The investment focus in the field of liquid biofuels should now be directed to second generation biofuels that are based on a new and improved feedstock base such as biomass waste or high energy crops instead of sugar, oil or starch crops and new conversion technologies such as enzymatic hydrolysis and biomass gasification cum synthesis technologies (CHOREN, Range fuels, Coskata, etc.). Here a totally new industry opens up that will also be able to supply a future biomass based chemical industry with its most essential intermediary molecules and building blocks.

Also considerable investments took place in the development of new preconditioning technologies of solid biomass such as torrefaction (Deutmeyer et al. 2012), flash pyrolysis and hydrothermal carbonization. First plants for lignocellulosic biomass are already operational in North America and Europe as well as first commercial torrefaction plants (New Biomass Energy/USA, Thermo/USA, etc.) (Deutmeyer et al. 2012).

9.2.2.3 Transportation and Handling

There are also a number of investment opportunities to be found in biomass logistics. Specialized rail wagons or high cube containers (such as e.g. “Innofreight” containers) to carry low density biomass fuels such as pellets or wood chips are increasingly in use and offer sound business models. Also specialized biomass hubs such as the Fibreco biomass terminal at Vancouver (BC) experience solid growth rates and profits for their investors. Also the European ports of Antwerp, Amsterdam and Rotterdam are getting prepared for an increase in biomass imports to the EU.

Although there seems to be no current shortage in long haul bulk carriers the focus of investments in biomass logistics lies in adequate storage and handling facilities that allow to store huge volumes of biomass fuels at the port and efficiently load these onto bulk carriers in order to reduce overall charter costs. The same holds true for the receiving ports that need to discharge, storage and transship biomass fuels in an equally efficient and low cost manner.

9.2.3 Basic Considerations for Investments

9.2.3.1 Biomass Demand

The greatest demand for imported biomass during the next decade will be from Europe, Korea and Japan. In *Europe* the “RE 20/20/20” energy policy carries legally binding renewable energy targets for each member country for 2020. Plans submitted by member countries in 2010 to achieve targets will increase biomass use for production of electricity, heat, and transportation fuels by ~400 MT (million tonnes), mostly based on woody biomass feedstock.

Pellet consumption of 9 MT in 2009 is projected to reach 16–18 MT by 2013–2015 and 50–80 MT by 2020. While Europe could meet the rising biomass demand by increased harvesting of her forests and from energy plantations, an increase in biomass imports is more likely since in most cases less costly.

The European biomass shortfall is estimated at 60 MT and leading to a high growth potential for biomass imports. Key importing countries will be UK, Netherlands, Belgium, Germany, Italy and Spain. In *North America*, the US and Canada do not have ambitious renewable energy plans, though support has been given for specific purposes; e.g. the US supports producing ethanol from corn for transportation fuel, but mainly to reduce dependence on Middle East oil and provide income to farmers. In Canada renewable fuel targets are low and on the verge of being achieved. An extensive natural gas distribution system makes the economics of bio-heat and biomass power difficult. Canada is expected to remain a net exporter of biomass to 2020. China’s new 5-year plan focuses on renewable energy. Domestic demand will increase substantially but it supports self-sufficiency and biomass trade is not yet envisioned. Korea has an ambitious target for renewable energy and a large scale import program (15 MT of pellets for co-firing). In post-tsunami Japan,

massive domestic and import biomass programs are contemplated that would increase demand for imported biomass to the same magnitude as Korea. Overall biomass import demand of these three key importing regions could add up to 90 MT by 2020 alone.

9.2.3.2 Biomass Supply

Globally, solid biomass is mostly traded in an open market, supported by energy policy. In 2009, 30 % of 13 MT of wood pellets produced were exported, primarily from Canada and the US. Bioethanol and biodiesel are subject to import tariffs and other restrictions, so even though biodiesel trade grew 0–80 PJ in 2005–2009 only 14 % was exported, and only 3 % of ethanol, 95 % from Brazil and the US. A growing portion of biomass for liquid fuels will be imported. Liquid biofuels will be from by-products of established industries, sugar, palm oil etc. Solid biofuels such as pellets, traditionally sourced from sawmill residues, will increasingly come from more intensive utilization of industrial, forestry and agricultural residues, inferior trees, and forests destroyed by fire, storm and insects. Canada has approximately 50 MT of excess biomass annually in mill residues, hog piles, unutilized allowable cut, non-merchantable timber and urban wood, and an almost unlimited wood supply from insect infested BC forests. Brazil has excess fibre from its forest industry, and potentially 25 MT of unused sugar cane bagasse. The US has large potential in the South-Eastern States. In the long term, supply will move towards biomass plantations on abandoned or under-used land in superior growing areas, and new regions. Coastal Africa has large tracts of diseased or invasive wood species. Argentina has untouched mill residues. Large land potentials are seen in South America, Africa, Australia, and parts of Asia. Plantations will require attention to ecological, political and cultural issues to avoid impacts on food and fodder production. Long term supply contracts will persist, but some will be traded as a commodities.

9.2.3.3 Bioenergy Risk

Like any investment, bioenergy has to deal with a number of risk. The most important risk to mitigate is the *supply of biomass* feedstock. Wind turbines are regarded as safe investments, though wind availability is uncontrollable. Biomass supply is controllable, storable, and can be guaranteed if based on dedicated production. Sawmill residue is low-cost, homogeneous, and often close-by, but supply depends on long term viability of the sawmill. Harvest residues may be plentiful, but often are not homogeneous, and supply systems are complex. Standing timber is often not owned, but available under licenses or market conditions. Wood plantations provide for long-term supply, but are at risk to sustainability issues. Agricultural residues are usually available only for a short period after harvest. Any bioenergy project must accept complex agreements to limit biomass supply risk as much as possible. Bioenergy is perceived to have high *technology risk* by investors, but that

is only the case with new non-commercial technologies. Most bioenergy projects have low technology risk; they use proven processes and equipment and have well understood supply chains. Pellet manufacturing is well known, whereas torrefying wood and subsequently pelletizing is still in its infancy. Worldwide 3–4 companies claim they are producing at commercial scale, but most are still at the pilot stage. Only one company has proven consistent production of pyrolysis oil at the commercial scale, while a second has produced for lengthy runs, but not over several years. **Transportation risk** can be significant, evidenced by the volatility in maritime shipping prices 2006–2009 due to demand for shipping by the Chinese economy. Such risk can be mitigated by long term shipping contracts, or dedicated specialized ships. **Regulatory risk** is a major factor. The economics of renewable energy, including wind solar and bioenergy, is supported by government incentives and renewable portfolio standards. Occasionally government policies may be reversed, evidenced by the withdrawal of feed-in-tariffs in the Netherlands. The safest markets are those in which economics of bioenergy are still acceptable in a regulation-free market. **Market risk** can be a factor. Pyrolysis oil is a very dense energy medium, but it is a new product not well known by potential markets. Bioenergy data is often scarce and public information poor, professional education and training is in its infancy. Like wind power, bioenergy is vulnerable to disinformation and adverse lobbying by competing stakeholders and by a misinformed environmental community. **Counterparty risk**, the risk of either party not being able to live up to its contractual obligations, can be significant, as in any business. For example, sawmill closures in Western Canada forced pellet suppliers to reduce production due to shortfalls in mill residue supply, and requiring pellet mills to find new sources of fibre. Pellet buyers had to secure volumes from an illiquid pellet market at high prices.

9.2.3.4 Country Risk

Countries with surplus biomass such as Canada, New Zealand and the US are viewed as low risk targets for investment due to stable political systems, western financial systems, solid infrastructure etc. Many other regions have surplus biomass and no meaningful domestic demand but are considered high risk. Tropical countries in East and West Africa, South East Asia and Latin America have very good growing conditions and under-utilized agricultural land, but for many European investors many of these regions are not on their radar screen. For biomass investments to be successful it is critical to assess and mitigate country risk factors in regions selected for investments. Individual country risk profiles should be developed, including political, legal, economic and cultural aspects. Quantitative country scorings and qualitative risk indicators can be used. Asset risks can be mitigated by developing modular plants or acquiring loading equipment that can be dismantled and moved if necessary. Regional risk can be further reduced by involving international and national financial or development institutions in investments, such as the IFC, World Bank, KfW, DEG, and participation

by reliable local partners that have lengthy business experience in that country. Win-win situations for both the fund and the regional population greatly enhance the security of the investment.

9.2.3.5 Investment Selection Criteria

It is the intent of any investment to make a satisfactory or superior return commensurate with risk. Investments in biomass value chains intent to maximize biomass trade; developing biomass in low-cost regions and profitably enabling long-distance transport with a landed cost lower than the market can supply internally. It might consider investment selection criteria as follows; maximize biomass supplied to markets, acceptable rate of return for risk, 50 % of investments in a positive cash flow, <30 % of investment in high risk regions, provide jobs in plant locations with a reliable work force, secured sustainable low-cost biomass feedstock base, secured off take agreements, 80 % proven technology, world scale facilities with competitive costs, low exchange rate risk, access to international shipping, high potential for efficient ground supply chain logistics.

9.3 Investors in Biomass Trade Supply Chains

9.3.1 Government

The role of governments as investors in international biomass supply chains are mainly restricted to direct investments in general infrastructure projects such as rail ways, transportation roads. These forms of investment support the possibility of the respective country to engage in the international trade of bioenergy products but in most of the cases are serve a broader range of development general goals.

More specific support for enhancing biomass trade is given more indirectly through the creation of suitable import and export legislation for bioenergy products, support in the development of new technologies for the production of specification driven bioenergy carriers, mandates for the use of bioenergy and renewable energy primarily in the transportation, heat and power sector and through direct subsidies in individual investments along the biomass to energy value chain – starting from subsidizing the establishment of dedicated biomass plantations up to the support in investment in bioenergy conversion facilities such as pellet stoves or biomass power plants.

9.3.2 Industry

The most important industrial investor into international biomass supply chains are European utilities that need to secure the needed solid biomass feedstock for current and future bioenergy mandates. They had realized that in an underdeveloped

international biofuel market with considerable long term price risks (and chances for private investors) a full integration into the biomass to energy value chain offers them a couple of advantages that set off the higher complexity of their bioenergy business model.

Companies such as e.g. RWE Innogy and Drax Power now have started to secure low cost woody biomass feedstock in Southern USA and are investing in large scale pellet plants (Waycross by RWE Innogy at 900,000 t/a; Bastrop/Gloster by Drax Power at two times 450,000 tpa, etc.) and port facilities (mainly large scale storage and efficient ship loading technology).

These investments will eventually pay off nicely since they will make use of the bioenergy base load of their investors and find a continuous and uninterrupted off take while at the same time providing essential insight information on the upstream part of the bioenergy value chain that are important to assess third parties' medium and long term contractual biomass supply offers.

Other investments, such as the one by Hafslund, a Norwegian power company, in a pellet plant (BioWood Norway), followed a different approach excluding the close geographical and economic integration into the feedstock source and just stopped operation before ever reaching full capacity. So pure size is not always a guarantor for a sound business model.

In addition to these effects these investments also increase market liquidity and will accelerate the process of commoditization of internationally traded bioenergy products. As soon as this phase has started those utilities will surely step out again and keep concentrating on their energy conversion and distribution business.

Individual utilities also started to support single technological developments such as direct investments in specific technology start-ups in order to see an early availability of advances in biomass preconditioning and conversion technologies. The investment of RWE Innogy's venture fund in a torrefaction start up (Topell) or sterling engine developer (Sterling DK) are just an example of such direct investments.

Similar investments are taking place in the bio fuel sector for similar reasons. Big Oil, agri-processors (such as ADM) and agricultural producers are being seen investing in both production facilities of first generation and second generation bio fuel plants as well as in biomass production and logistics.

The investment of international companies into bio fuel projects are numerous such as BP's total of seven billion USD investment in alternative energy since 2005. Also ExxonMobil is spending 600 million USD on a 10-year effort to turn algae into oil and Royal Dutch Shell has invested billions of dollars in a Brazilian bio fuels venture, buying up sugar cane mills, plantations, and refineries to make ethanol. In the U.S., Shell produces small lots of so-called drop-in bio fuels—engine-ready products that can replace gasoline—from a pilot plant in Houston that uses sugar beets and crop waste and had investments into CHOREN (a former German BTL technology company) or Iogen, a Canadian based second generation ethanol producer.

Although not all investments have been a success and not all announced projects finally had been realized, international energy companies are still the largest single group of investors into bioenergy and international bioenergy supply chains.

9.3.3 Institutional Investors

Institutional investors are generally risk averse and focussing more on the long term maintenance of value than quick and high gains. At the same time they can and only will offer significant amounts of financial resources for single projects and would be the ideal partners for investments with a low perceived risk and high upfront investment. The purchase of large areas of land for e.g. dedicated biomass production would be such a case where the institutional investor takes ownership of the land renting it out to an operating entity that takes all the risk and potential gains from growing energy crops on it. Also large biomass conversion facilities based on bankable technical performance guarantees, long term biomass supply agreements and feed in tariffs and run by an experienced operating company could be another example for suitable investment opportunities for this kind of investor.

Interested private or institutional investors in this investment class could also delegate the work of project evaluation, project selection and development to specialized bioenergy funds that focuses its activities along the biomass to energy value chain.

9.3.4 Private Investors

Private investors – due to their own restricted capital resources and restricted access to other capital markets – tend to focus on single and easy scalable investments along the biomass supply chain starting from dedicated biomass production such as farmers or forest owners to mostly biomass collection and biomass transport. Only if supported by venture capital or if combined with existing operations private investors venture into biomass preconditioning such as setting up a pellet plant adjacent to their saw mill. Quite a few private investors can be seen investing in initial stages of technology development almost always facing the problem to find additional investors to support the construction of demonstration plants and the commercialization of the technology.

9.4 Financing Investments in Biomass Supply Chains

9.4.1 Grants and Subsidies

Feed in tariffs, biofuel quotas, production obligations and other forms of subsidies are all geared towards increasing the investment in bioenergy use and bioenergy production and certainly do have direct and indirect effects on investments into the

bioenergy sector as well as into international bioenergy supply chains. Besides increasing the price for some bioenergy products it is mostly the increase of absolute demand or total volumes that have the biggest effect on the growth of international bioenergy trade.

In many cases bioenergy mandates or demand cannot be satisfied at sustainable price level through local or national production so that low cost and/or underutilized biomass resources from other regions in the world can be used to flatten the supply curve and stabilize both prices and volumes needed.

In addition to these subsidies there are possibilities to cover part of the needed investment into biomass supply chains by direct grants. Investments in infrastructure, technology, forestry and agriculture especially in developing countries are often eligible for grant financing of up to 60 % of total investment costs.

A number of donor agencies and development banks provide for such assistance in order to foster sustainable forestry and agriculture, international trade, technology transfer and introduction of renewable energy.

Also in the area of bioenergy both for local consumption as well as for export quite a number of grants are available (PSI, EU ACP, NCF, EEP, KfW, etc.). Investments into the production of dedicated and sustainable biomass production can also be set up as CDM projects so be co-financed by selling up front their CERs after project validation. Also the costs of validation and CDM project development can be financed by specialized grants.

Experience in the sustainable use of grant financing has shown that grants should primarily be used to support investments that are basically economically viable without any grant once operational but do need grant support in order to cover perceived country risks and introduce new technologies, know-how and investors into underdeveloped sectors. It is this specific aspect where the often required ‘additionality’ of grant applications have to be asserted.

Local and regional development banks (see e.g. www.iadb.org, www.adb.org, www.afdb.org) are usually a good source of information – besides well-known internet search engines – to start looking for investment grants. But also investments in more developed countries are eligible for direct financial support. For example the American Recovery and Reinvestment Act, or the stimulus package, has allocated billions to renewable energy, and biomass is one of the key focus areas. By leveraging these grant, loan guarantee and tax incentive programs, it is possible to get a well-planned and organized biomass project funded today in the USA (see e.g.: www.grants.gov, www.dsireusa.org, etc.). These government programs are geared towards bridging the gap in funding biomass projects until the industry matures and traditional capital becomes available.

Also European governments are very supportive in the area of biomass conversion technology development and offer a wide array of supportive schemes and grants especially for the initial stages of product development. It is most often commercialization step of new technologies that are the most difficult to finance. They are often too advanced to be eligible anymore for government grants and still too risky for private investors to step in.

9.4.2 *Debt*

Another source of capital is bank financing via debt. Here it is important for the project developer to meet and satisfy the “Bankability Requirements” for financial institutions to make available debt financing for the construction and implementation of a biomass project.

All major project risks have to be identified and their effect on the project economics and its ability to repay the loan need to be understood and discussed. For a bioenergy project the most important risks factors as discussed in Sect. 9.2.3 are usually:

- forward price risk
- biomass availability risk
- project completion risk
- long term demand risk
- transportation and logistics risk
- new technology risk
- sustainability criteria risk (or the absence of applicable criteria), etc.

The project promoter needs either to allocate these risks to third parties via contractual arrangements or at least greatly mitigate these risks via intelligent hedging, conservative modelling, greater project flexibility, knowledgeable investors and supportive business partners.

Besides the above mentioned development banks, debt could be provided by any kind of bank interested in well-structured and sound bioenergy investments. However, banks specialized on renewable energy and/or development projects tend to have a better understanding and assessment of the different risks incurred by a specific project proposal and can come up with both better advice for the project promoter how to mitigate those risks and better financing conditions.

9.4.3 *Private Equity*

A significant share of equity financing of generally between 25 and 50 %, is the precondition of any of the above mentioned sources of financing – such as senior debt – to become available. Equity finance bears most if not all of the risks involved in any kind of investment and the more sophisticated equity providers will focus on these same risks as the banks do as part of their pre-money due diligence.

Securing equity financing is therefore the biggest obstacle for any project developer. Sources of equity can be local investors, strategic partners, equity funds and tax equity.

The ability for biomass-to-electricity companies to claim investment tax credits, production tax credits, bonus depreciation and accelerated depreciation opens up the door for tax equity investors for examples for US based investments or in any

other country were similar support is provided. With a declining tax equity market e.g. in the US during the last years due to the general unfavourable economic environment it is now possible to get a grant from the federal government instead of the 30 % investment tax credit for certain biomass projects.

Most valuable sources of equity are those of either from strategic partners that at the same time will support the investment as e.g. future suppliers or off takers or from knowledgeable investors and industry insiders that will not only provide the needed capital during project initiation and development but be a constant source of industry intelligence and advise during continuous operation. In addition, having successfully secured equity finance can in most cases be seen as a prove of project quality and economic viability and alleviates the receipt of additional needed debt financing and grant money.

Although equity finance eventually asks for the highest rewards it comes at no cost for the project unless profits are being made and other financing costs have been served.

9.5 Synchronize Investments with Existing Mandates and Future Biomass Demand

9.5.1 Possible Effects of Under Investments

As mentioned above, general observations have resulted in the conclusion that investment in the field of international trade of bioenergy meet obstacles and difficulties with regard to raising capital (Bradley et al. 2010). The reasons relate to several factors: uncertainty, lack of statistics and performance data, institutional issues, political and currency risks, etc.

On the general level the “under-investment” leads to limitations of international trade and therefore in most cases a reduction to the access to cheaper bioenergy on the international market. That in turn favours local producers because of less competition, while it increases prices for end consumers. In national or local markets where bioenergy is subject to subsidies, limited imports of low cost bioenergy put an extra burden on public budgets and on tax-payers.

Looking at more specific effects of under-investment, one should distinguish between different supply chains. Ethanol and vegetable oils, and residues like PKM, PKS (palm kernel shells), etc. are traded in well-established forms in or parallel to the trade of food and fodder products emanating from the same production processes. Under-investment problems are less pronounced for these supply chains than for other bioenergy, and could be absorbed by the capacity of the trade actors, who normally are big companies in all the links of the supply chains. The major problems for international trade in this segment relate to political and environmental rules and regulations.

Thus, under-investment is found mainly for newly developed trade patterns and for new bioenergy fuels such as wood pellets, torrefied biomass products, pyrolysis

oil, etc. Below, some effects of under-investment and other financial restrictions are listed.

For several years after the EU targets for 2020 were decided upon, *very little investment in new combustion capacity* took place in the European power utility sector. Apparently, in these years financial subsidies were too low to support investment in new bioenergy based generating capacity. As the utilities have a key role in the transformation of the energy sector to reach the 2020 targets, some national governments have increased the financial support to levels where utilities start to act, leading to large scale and fast investments in bioenergy capacity. These stop and go decisions have had negative effects on actors in the supply chains, and have also contributed to the uncertainty regarding bioenergy trade in within the financing community.

Production projects aiming at long distance supply of bioenergy can be classified into three main categories:

- Stand-alone projects
- New products in large corporations
- Upstream project for energy utilities

Regarding the effects of under-investment, the following points could be made:

- A typical *stand-alone project* for bioenergy has to rely on the general finance market for most of the capital. The project developer then meets the arguments from the financing bodies that the uncertainty should be reduced or absorbed by firm agreements for long term off-take, raw material supply, technology guarantees, shipping, etc. This puts the project developer in a very weak negotiation position vis-à-vis these agreement providers and the required commitments would be disadvantageous, sometimes far from reasonable market conditions. At this point of the process, several projects have been cancelled. Among the remaining projects, only few have survived under the original conditions.
- A number of bioenergy projects have been developed as a *new production line* complementing the product programs of established corporations. Examples can be taken from the technology, forestry and shipping businesses. Financing in these cases has been easier than for stand-alone projects, especially in cases when the corporation possesses a good reputation and a solid balance sheet. Still in several projects under-investment has been at hand, mainly regarding investment in marketing, raw material acquisition and management organization. The fact that bioenergy trade still is immature and is lacking norms and institutions means that more attention should be given to soft project functions.
- In recent years several examples of *up-stream investment by energy utilities*, etc. have taken place, e.g. for pellets and ethanol. Many of these projects are large scale investments focusing on captive supply of bioenergy to own facilities. As most of these utilities are well established in the financial markets, and the fact that the off-take is guaranteed by internal captive use, financing can be arranged within established structures. In addition, many of the captive large scale projects are supported by public funds, projects in developing countries from foreign aid

funds. Moreover, export projects located in the US benefit from support from state investment funds, and also from subsidies under the federal Farm Bill.

Thus, the financing problems in bioenergy leads not only to general “under-investment” but also to the emergence of a structure in which the large utilities have the power to set the rules, to influence the pace, and to develop institutions for the bioenergy trade. Other equally sized sectors in the bioenergy fields, e.g. the small and medium scale heat markets, small fuel producers, independent agents and distributors will suffer more from limitations of finance and have great problems in developing roles for themselves in the growing international trade of bioenergy.

9.5.2 Mandates and Financing

In several cases, mandates are set up to enhance Renewable Energy. The 20/20/20 target for the EU is one example; similar schemes have been launched in Korea, Japan and in other countries.

The policy base for the mandates have been developed and decided upon on political levels. Thus, the mandates comprise several political goals in addition to environmental and renewability issues also jobs, innovations and increased self-sustainability are included. The financing of the implementation of the mandates reflects the political targets, however, the rules and regulations show a wide array of administrative arrangements, from support directly from the national budget to compulsory quota, etc.

In most cases, bioenergy is regarded as a key element in the policy. However, even in cases where it is obvious that the mandated target would lead to large scale import of bioenergy, very little if any attention has been given to activities aiming at the development of the efficiency of the supply chains of international trade. This approach may partly be explained by the fact that imported bioenergy in many cases would be considerably cheaper than what can be domestically produced and support to import could therefore meet political and other resistance from domestic producers.

Another reason may be that it is assumed that support in one link of the chain, e.g. feed-in tariffs, would mobilize the market forces in the entire chain. As has been high-lighted in other parts of this chapter, this assumption would not be true due to the specific financing difficulties for multi-faced bioenergy supply chains for international trade.

Another, probably unexpected, effect of the mandates relates to the roles of big utilities for reaching the mandated targets. In many countries, e.g. the UK, the Netherlands, Denmark, Japan and Korea, power utilities are regarded as key actors in that process. That has given them a strong platform for negotiation with governments, etc. regarding support measures. In some countries this negotiations are ongoing and consequently no or little activities take place, in other countries the negotiations have led to satisfactory conditions for the utilities, triggering fast and

large-scale actions. Import of bioenergy is an obvious key element in that progress. For these corporations, financing can be organized “in-house”, thus the uncertainty factors can be absorbed within the corporation.

Generally, bioenergy trade is not recognized as a key element in present mandates and related policy measures. It seems obvious, that the “market forces” alone would not be able to lead to efficient supply chains. A major factor for the market failures relates to perceived uncertainty, which in turn causes financing problem.

Mandates do work to initiate investments if they are

- long term to allow for sufficient time for the needed investment horizon. The mandates should be designed in order to fit with the policies of the financing sector. For equity financing in long-term projects, the pay-back time is typically 5–10 years; for loans normally somewhat longer. If mandates have shorter horizons, the financing sector would regard that as an uncertainty factor leading to higher rates and shorter amortization times, etc., which in turn will cause i.a. cash flow problems during the most sensitive first years for the investment projects.
- reliable and grandfathered (don’t change the rules during the play) (see above) Mandates should be consistent and comprehensive and include visions and explanations on why the mandate is introduced. The development of mandate should be carried out in parallel with the development of measures to gain acceptance from the general public for the need to transform the energy system.
- financially affordable (make sure financing can be made available as needed either via flat increase or direct financial incentives and support). Mandates that are based on financial support directly from the state budgets have proven to be shaky in periods of financial crises. In that perspective, other solutions e.g. carbon taxes or quota would be preferred.
- technically achievable (no mandates for products or technologies that are NOT commercially available). It is important to distinguish between support to R&D projects and support to implementation of proven solutions in this case to investments in projects in the supply chain for bioenergy trade. R&D projects may need seed money, and step-wise increases related to progress while investments in the supply chain for proven technologies require support policies like those described above.
- enforceable (have rules to penalize). Mandates that are not enforced via a penalty are no mandates. The penalty has to be well above any potential economic gain that could be achieved in not meeting the mandate.

9.5.3 Possible Ways Forward

In order to enhance the investment climate along sustainable international biomass supply chains a number of needed and/or enhancing prerequisite can be listed that both industry and policy should focus on:

- ***Assure sustainability of feedstock production through certification.*** While formal certification might be required in early phases of an emerging bioenergy trade

development to motivate political support measures and to safe-guard against abuse, it is likely that the bioenergy trade will develop more transparency and that other measures could replace formal certification, e.g. verification and monitoring carried out by the trading parties and other stakeholders. An established trade would mean that parties in the links have a genuine interest in smooth performance and in avoiding criticism from third parties.

- ***Balance supply and demand through focus on integrated supply chains to develop the market.*** Such an approach will inherently guarantee security of supply for each investment and reduce an important risk factor by doing risk so while at the same time reduce financing costs.
- ***Foster commoditization of specification driven bioenergy carriers for international trade through international cooperation on standardization, harmonization.*** This approach would quickly increase the liquidity of the biomass feedstock and bio fuel market and allow for better risk mitigation and sourcing flexibility as well as for more investment into direct feedstock production.
- ***Focus in international bioenergy trade on few preferential bioenergy products that have the potential to be produced, shipped and used in large quantities worldwide.*** That focus would allow for an even faster growth of certain supply markets, reduce insecurity within a nascent industry and mobilizes even more financial resources. Economies of scale are significant in the bioenergy value chain and reduced overall costs could eventually lead to independence from any political support schemes in certain energy sectors – as is nowadays happening already for domestic heating applications.
- ***Provide a stable, favourable and reliable economic environment for trade to grow.*** The conditions for bioenergy trade have been very different with regard to market incentives, types of fuels, political policies, roles of key actors, etc. Also factors like economic trends and weather have fluctuated. To a large extent it has been the “buyers market’s”, meaning that much of the risks and uncertainty have been placed on early links in the supply chain. The general policy targets set up by UN bodies, EU, etc. provide a structure for the development of balanced and harmonized future conditions.
- ***Avoid overcompensation by direct subsidies and stay away as much as possible from the use of food and fodder products to avoid market distortions and negative political repercussions that might result in an abrupt change of policy and mandates.*** The long term aim of support measures, if needed, should be harmonization between all renewable energy systems. The WTO policy should prevail, i.e. not allowing direct subsidies for products subject to international competition. The present controversy about the “food versus fuel” would be reduced by demonstration of positive effects of biomass production for energy, e.g. by application of agro-forestry, utilization of agricultural waste, transferring marginal agricultural land into energy plantations, etc. In particular, the socio-economic effects should be in focus.
- ***Provide better support for the market introduction of new bioenergy trade related technologies through industry consortia, a culture of venture capital and performance based grants.*** The application of efficient technologies and

methodologies is a key factor for compatibility of new or expanded projects. However, availability of those techniques and methods is not globally at hand, especially with regard to developing countries. Many, if not most companies in the bioenergy technology industry are small with limited resources for expansion into new markets. This problem is recognized, e.g. in the documents from Climate Change Summits, suggesting that specific fund resources should be earmarked for making technology available for developing countries.

- ***Finally provide a stable regulatory environment that incentives government, industry and private investors to invest along international biomass supply chains.*** In a few cases, examples that development has taken place, and others may follow. However, on the policy level, several issues have to be resolved, e.g. support to domestic supply chains versus import chains, application of quota or incentive measures (“stick or carrot”), and focusing on advanced or proven technologies.

9.6 Synthesis

Rising fossil fuels prices, ever more efficient production, transportation and conversion of biomass based fuels and the growing political will to reduce CO₂ emissions will lead to a continuous rise of the use of biomass products also in the energy sector worldwide. In order to balance demand and supply the share of internationally traded biomass fuels will even increase in the future.

This effect offers a wide range of investment opportunities along the whole value chain of international biomass supply. But biomass to energy value chains are far more complex than any other form of renewable energy and pose a whole new set of ecological, technical, logistical and commercial challenges. So financing and managing the growth of this new industry is not easy and will take more time in relative terms but reach higher levels in absolute terms in comparison with other renewable energy sectors.

The growth of sustainable energy biomass production, use and international biomass trade is a very positive trend that needs to be supported and steered by far sighted policy making sure that policy measures give enough support to biomass based fuels to assure their long term competitiveness with fossil based alternatives as well as their overall sustainability.

Overall policy measures to increase the use of biomass for energy certainly did lead to an increase in bioenergy use so far and as long as policy support is needed to support the development of this energy sector the more these policies have to gain the trust of the investment community in order to provide for the needed long term finance.

Biomass is the only primary renewable energy source that can be stored and transported over long distances. Its overall worldwide sustainable potential is large and it has the potential to serve not only the energy market. In light of these fundamentals investments in biomass supply chains offer a very positive long term perspective.

Appendix

Selected general internet links

- <http://www.risiinfo.com/>
- <http://www.hawkinswright.com/>
- <http://www.crossborderbioenergy.eu/>
- <http://about.bnef.com/>

Selected funding agencies in different countries:

USA:

- USDA Business & Industry Guaranteed Loans (B&I Loans) http://www.rurdev.usda.gov/rbs/busp/b&i_gar.htm
- USDA Renewable Energy for America Program (REAP) Guaranteed Loans <http://www.rurdev.usda.gov/rbs/busp/9006loan.htm>
- Biorefinery Assistance Program <http://www.rurdev.usda.gov/rbs/busp/baplg9003.htm>
- DOE Innovative Technology Loan Guarantee Program <http://www.lgprogram.energy.gov/features.html>

Africa:

- African Development Bank, www.afdb.org

Asia:

- Asian Development Bank, www.adb.org

EU:

- EBRD, www.ebrd.com
- EIB, www.eib.com

Germany:

- KfW, www.kfw.de
- GIZ, www.giz.de

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